**Introduction**

OK, teammates, today your job is to work as a team on a webquest about Boyle’s Law and Charles’s Law. The websites you need are included in this packet. You may NOT use Google or Ask.com. You will find questions to answer or statements to complete below each website. There will also be diagrams and animations to observe and at least one animation to participate in. You will not complete the quest in one class period. Hopefully, you will gain a better understanding of these 2 gas laws.

**Task**

On this quest, you will be working in teams of 2 (or 3), gathering information from each website listed. There are 2 jobs in each team: the navigator and the data recorder.

Navigator – is responsible for logging in, navigating the Internet – using the touch pad and maneuvering around the websites, and logging out.

Data Recorder – records all data NEATLY in your packet (teammate will copy answers later).

At the halfway point…you will switch positions (don’t move the laptop). Take 30 seconds and decide who will be the first navigator.

At the end of this WebQuest, there will be 2 evaluations. The first evaluation is a team evaluation. You will evaluate the job you and your teammate did on the quest. The second evaluation is your teacher’s evaluation of your job and how well you worked as a team.

Finally, you may go back to any of the websites you choose and search for other interesting facts about the gas laws.

**Process**

The first website is the Merriam-Webster Dictionary website. Use this site when you come across an unfamiliar word. Remember…since this is a Word document, not a web page, you need to hold the Ctrl key down when you click on the links.

<http://www.merriam-webster.com>

Close this website.

Continue to the first link on Boyle’s Law.

<http://www.chm.davidson.edu/vce/GasLaws/BoylesLaw.html>

1. One of the earliest studies on gases was conducted by Dr. Robert Boyle in \_\_\_\_\_\_.
2. Describe the tubing Dr. Boyle used. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Scroll down to Part 1. Observe the manometer. Here atmospheric pressure is added to the pressure exerted by the column of mercury.

[http://en.wikipedia.org/wiki/Boyle’s\_Law](http://en.wikipedia.org/wiki/Boyle's_Law)

1. Boyle’s Law describes the inversely proportional relationship between the absolute pressure and volume of a gas, IF the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is kept constant within a closed system.
2. Click on Pressure. P is the force per unit area applied in a direction \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to the surface of an object. Return to main page.
3. Click on Volume. V of any solid, liquid or gas is how much \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ it occupies. Return to main page.
4. Boyle’s Law is sometimes referred to as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

<http://www.grc.nasa.gov/WWW/K-12/airplane/boyle.html>

1. For a given mass, at constant temperature, the pressure time the volume is a constant. Write the equation: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. In the diagram, the pressure was increased from 1.00 to \_\_\_\_\_\_\_\_.
3. How did they add pressure? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. What is the constant in both diagrams? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. Click on properties. All matter is made from \_\_\_\_\_\_\_\_\_\_ with the configuration of the atom determining the kind of matter present.
6. Oxygen and nitrogen, which are the major components of air on Earth, occur in nature as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ molecules, meaning \_\_\_\_ atoms.
7. Atmospheres are composed of gases, which have a very large number of molecules that are 1.) weakly attracted or 2.) strongly attracted to each other and are free to move about in space. Underline the correct answer. Return to main page.
8. Click on state. Compare Boyle’s Law and Charles and Gay-Lussac Laws. Record both formulas: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
9. Return to main page and scroll down to view animation. As the pressure increases from 1.00 to 2.00, the volume \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. How was the pressure increased? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

<http://www.chem.iastate.edu/group/Greenbowe/sections/projectfolder/flashfiles/gaslaw/boyles_law_graph.html>

Drag plunger up as close to 25 on pressure gauge as you can. Record Pressure (psi) and Volume (mL) for each of the following:

Air: mL \_\_\_\_\_\_\_\_\_\_ psi \_\_\_\_\_\_\_\_\_\_

Hydrogen: mL \_\_\_\_\_\_\_\_\_\_ psi \_\_\_\_\_\_\_\_\_\_

Oxygen: mL \_\_\_\_\_\_\_\_\_\_ psi \_\_\_\_\_\_\_\_\_\_

Helium: mL \_\_\_\_\_\_\_\_\_\_ psi \_\_\_\_\_\_\_\_\_\_

<http://www.wisegeek.com/what-is-boyles-law.htm>

1. The standard measurements for volume and pressure are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

1. A syringe is an example of Boyle’s law in action. The volume of a fixed amount of gas is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ by drawing the handle back, thereby lessening the \_\_\_\_\_\_\_\_\_\_\_\_\_. The blood in a vein has \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ pressure than the gas in the syringe, so it flows into the syringe, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the pressure differential.
2. Another way of describing Boyle’s Law is that when you push a gas, it \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

1. What happens when we reach the limit to the amount we can compress any given gas? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

<http://home.flash.net/~table/gasses/boyle1.htm>

1. Where do we notice changes of pressure? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Why? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Normally, we don’t feel the pressure on us because \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
3. Read the example about the balloon. What happens to the volume of the balloon when taken to a depth of 33 feet of water? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to a depth of 66 feet? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to a depth of 99 ft.? \_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

<http://www.grc.nasa.gov/WWW/K-12/airplane/boyle.html>

This takes you back to the NASA site. Scroll down to the bottom of the page.

1. Click on Animated Gas Lab. Read the first paragraph, and then click on Animated Gas Lab. You are going to FIX two of the four primary properties and study the nature of the relationship between the other two by varying one and observing the variation of the other.
2. Freeze Mass & Volume – Click “Effect of changing pressure on temperature.” As the pressure increases, what happens to the temperature? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Click “Effect of changing temperature on pressure.” As the temperature increases, what happens to the pressure? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. How was the temperature changed? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. The piston holds the volume \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
6. Click new case. Freeze pressure & temperature. Click “Effect of changing mass on volume.” The mass is changed by injecting molecules at the left. The density (mass/volume) remains a constant for constant pressure and temperature. What is the effect of increasing the mass? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

<http://www.youtube.com/watch?v=l630uy4ALFs&NR=1&feature=fvwp> (We will watch together.)

**SWITCH JOBS**

Now we will investigate Charles’s Law.

<http://www.chm.davidson.edu/vce/Gaslaws/CharlesLaw.html>

1. Two prominent French scientists, Jacques Charles and Joseph-Louis Gay-Lussac, made detailed measurements on how the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ of a gas was affected by the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the gas. Given the interest in hot air balloons at that time, it is easy to understand why these men should be interested in the temperature-volume relationship for a gas.
2. Jacques Charles took care to keep all properties of the gas constant except for \_\_\_\_\_\_\_\_\_\_\_\_\_\_ & \_\_\_\_\_\_\_\_\_\_\_\_\_\_. The equipment used by Jacques Charles was similar to that employed by Robert Boyle. A quantity of gas was trapped in a J-shaped glass tube that was sealed at one end. This tube was immersed in a water bath; by changing the temperature of the water Charles was able to change the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the gas. The pressure was held constant by adjusting the height of mercury so that the two columns of mercury had equal height, and thus the pressure was always equal to the atmospheric pressure.
3. Intuitively, it is expected that the volume of the gas will \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ as the temperature increases.
4. Write a definition for absolute zero. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. Plot the following:

160 degrees C and Volume (mL) 400

200 degrees C and Volume (mL) 600

240 degrees C and Volume (mL) 800

Type in, and then click Add Point.

Observe the graph. Does it plot a straight line? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Click on Calculations using Boyle’s Law. Scroll down to Part 1…click on New Condition…observe. List one Volume of Left Bulb & one Volume of Right Bulb \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

[http://en.wikipedia.org/wiki/**Charles's**\_**law**](http://en.wikipedia.org/wiki/Charles's_law)

1. **Charles' law** is also known as the **law of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**
2. Charles’ law describes how gases \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
3. Observe the animation. What happens to the volume as the temperature increases?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

<http://www.fordhamprep.org/gcurran/sho/sho/lessons/lesson75.htm>

1. **An inflatable pool float may seem quite firm as it sits on a deck in the hot sun.  However, minutes after you toss the float into the cold pool, the same float may seem under-inflated.  You may suspect the float developed a slow leak, but that may not be the explanation for the apparent loss of air pressure.  Charles's law may be responsible. Explain what happened. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
2. **Gases expand as they are heated and they contract when they are cooled.  As the temperature of a sample of gas at constant pressure increases, the volume \_\_\_\_\_\_\_\_\_\_\_\_.  As the temperature goes down, the volume \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**

<http://library.thinkquest.org/12596/charles.html>

1. Assuming that pressure remains constant, the volume and absolute temperature of a certain quantity of a gas are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
2. Copy the 3 mathematical concepts:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Assuming that pressure does not change, a doubling in absolute temperature of a gas causes a doubling of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of that gas.

<http://www.grc.nasa.gov/WWW/K-12/airplane/aglussac.html>

1. Observe the animation. What happens to the volume as the temperature increases? \_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. What is the constant in this animation? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

[http://www.chalkbored.com/lessons/chemistry-11/**charles**-**law**.ppt](http://www.chalkbored.com/lessons/chemistry-11/charles-law.ppt) (This ppt is also uploaded to Sharepoint in the Webquest folder.)

1. Look at slides 1, 2, 3, 4, 7
2. What happened to the balloon when it was dipped into liquid nitrogen? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. What makes a hot air balloon rise? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. V/T = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. Charles’s Law: as the temperature of a gas increases, the volume increases proportionally, provided that the pressure and amount of gas remain constant, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

<http://www.chem.iastate.edu/group/Greenbowe/sections/projectfolder/flashfiles/gaslaw/charles_law.html>

1. Slide temperature to approximately 275◦, then 250 ◦, then 225 ◦, then 200 ◦ Click on “Show Data Table,” record Volume (cm2 ) for each\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Click “Show Plot.” Then, hide plot, clear data, and close.

<http://www.1728.com/charles.htm>

1. English Translation?

When temperature increases, volume increases.

When temperature decreases, volume decreases.

1. Click on Volume. Type 250 for Temperature 1; 300 for Temperature 2; 5 for Volume 1. Calculate. Volume 2 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Try changing Volume 1 to 100 and calculate. Volume 2 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

<http://www.youtube.com/watch?v=IkRIKGN3i0k> \*\*\*We will watch together \*\*\*

**PA Standards**

Jan and Tim…I need these from you.

**Evaluation**

**FINALLY…** go back to the animated Gas Lab found at:

<http://www.grc.nasa.gov/WWW/K-12/airplane/Animation/frglab2.html>

Freeze other combinations and observe the results. One combination is an example of Charles’s Law.